C3P-NASA Technical Workshop

Lisbon, Portugal
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Project Area Overview

Technology Migration Opportunities

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Nonchromate Primers for Aircraft Exteriors

Objective:

- Identify and qualify environmentally acceptable alternatives for chromate-containing primers used on military aircraft exterior mold line skins that are reworked at military depots which will reduce chromium emissions, reduce hazardous waste and reduce waste management costs

Benefits:

- Reduce raw material costs
- Reduce regulatory and financial liabilities
- Reduce worker exposure

C-17

F-15

Technology:

- 10 alternatives screen tested
- Alternatives selected for field testing:
  - Akzo Nobel 10PW22-2/ECW-119
  - PRC DeSoto EWAE118
- Tested on: C-17, C-130, F/A- 18, F-15, T-45, AV-8 aircraft and HARPOON Canister – through migration Lockheed-Martin testing of F-16

Nonchromate Primers for Aircraft Exteriors (continued)

Accomplishments:

- Field testing continues for six months on C-130, F-15, F-16, and KC-135 aircraft
- Two F-15 aircraft have completed six year depot cycle
  - Final inspection showed no discernible difference between chromate and nonchromate primers
  - Technology migration to NASA

Final Results:

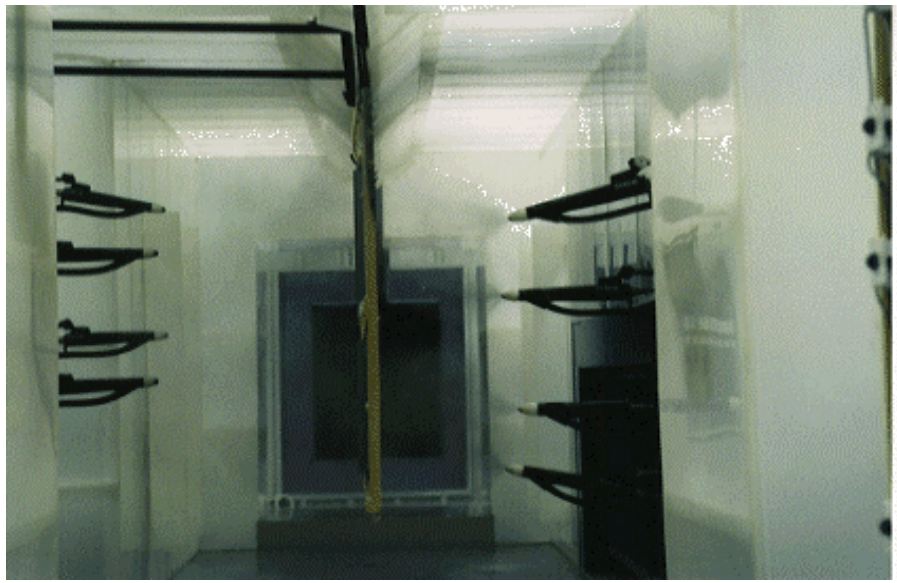
- Complete revision of MIL-PRF-85582
- and –23377 to include change in failure
- critical (allow some corrosion and scribe)
- Fully Documented - PAR, JTP, CBA,
- Field Evaluation Reports and 2 JTRs

NASA Space shuttle flipper door

Alternatives to Low-VOC Topcoats and Primers

Objective:

Qualify low volatile organic compound (VOC) coatings for use on aluminum electronic housings for a number of defense systems manufactured by Raytheon Systems, Dallas, TX.



Benefits:

- Reduced VOC emissions
- More durable coatings
- More efficient production
- Reduced worker exposure

Technology:

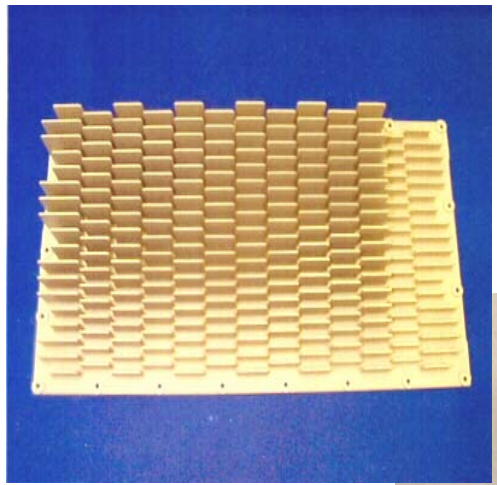
- Epoxy powder coat and a 100% solids coating were subjected to over 30 critical performance tests identified in a Joint Test Protocol (JTP).

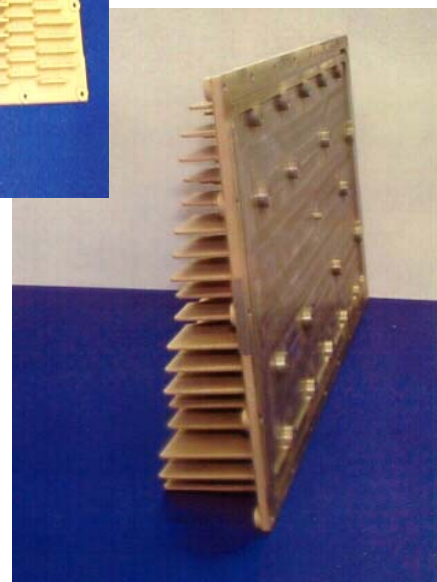
- The powder coat met all the JTP requirements, and was deemed an acceptable alternative. The 100% solids coating failed to meet all the requirements.

Alternatives to Low-VOC Topcoats and Primers *(continued)*

Accomplishments:

- Tested and qualified a new formulation of paints that involves chemical agent resistant coating (CARC) powder paint technology
- Provides a non-VOC, non-hazardous alternate material for applications using MIL-C-46168, Urethane, Camouflage, Infrared and CARC qualified
- Low VOC Topcoats and Primers – Implemented





- **Final Results:**
- Reduce VOC emissions 100%, eliminate
  - Toluene, Xylene, Methyl Ethyl Ketone
- Material cost savings of $1.20/square foot
- Eliminates masking/de masking operations
- Average labor savings per part 3 hours
- Increased technical performance and quality
  - Quality deficiency reports reduced by 65%
  - Customer product satisfaction increased significantly
- Project Cost $ 750 K
- Estimated Savings $ 640K/year
- Return on Investment 1.2 years

Low/No -VOC Identification Marking

Objective:

- **Identify and qualify low-VOC inks and labels used for identification marking that reduce or eliminate the use of VOCs (specifically MEK and toluene) and reduce hazardous waste (rags, ink, and solvents) which will reduce waste management costs.**

Benefits:

- **Reduced labor costs in rework and flow-time**
- **since no masking, unmasking, cleaning**
- **Reduce raw material costs**

Technology:

- **Testing consisted of applying ink and**
- **label alternatives onto bare and coated panels**
- **9 inks and 10 labels tested**

Low/No -VOC Identification Marking (continued)

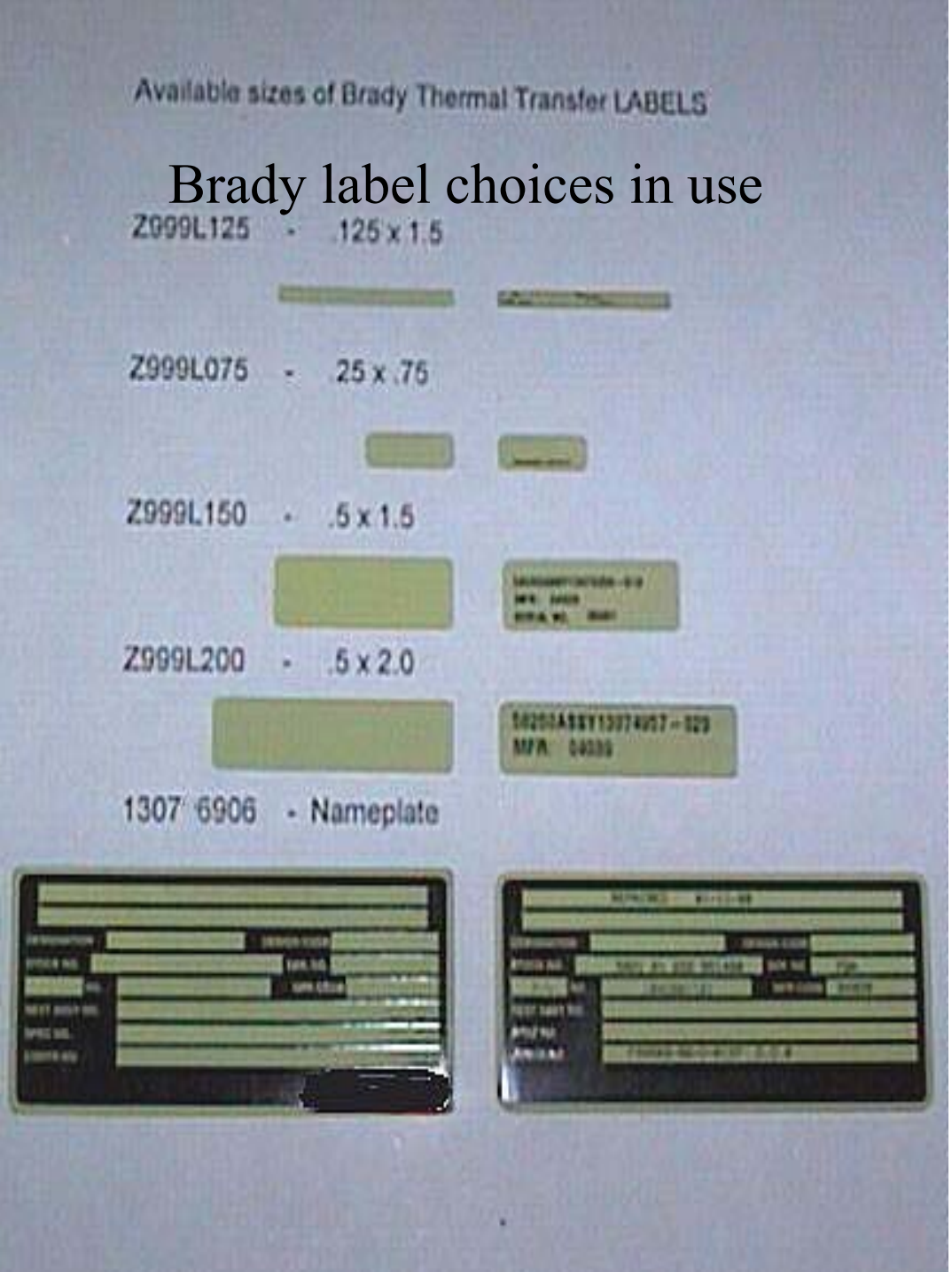
Technology (continued):

- **Qualified alternatives**
  - **Inks - DPI 311 (Dell Marking Systems, Inc.) and Wilmark #44 (Willard Marking Devices Corporation)**
  - **Label systems - Chritchley Clear Polyester, Chritchley Metallized Thermal Transfer, and Chritchley White Polyester Film (Tyco Electronics)**
  - **Point and click to bring up software package, point and click to bring up file, and point and click to print**
  - **Print speeds of 2 to 6 inches per second**
  - **Capable of printing serial numbers in sequence**
  - **Can print barcode, alpha-numeric or both**

Accomplishments:

- **Implementing low-VOC inks and a thermal transfer printing technology**
  - **Navy Packaging, Handling, Shipping and Transportation Center (PHST) and received contract at Point Mugu, California**
  - **NAWC In-Service Engineering Laboratory at Point Mugu, California**
- **Thermal transfer computer and printer technology < $3,000**
- **Annual cost benefit: $33,000 – $618,800 (range based on percent implementation)**

Brady label choices in use

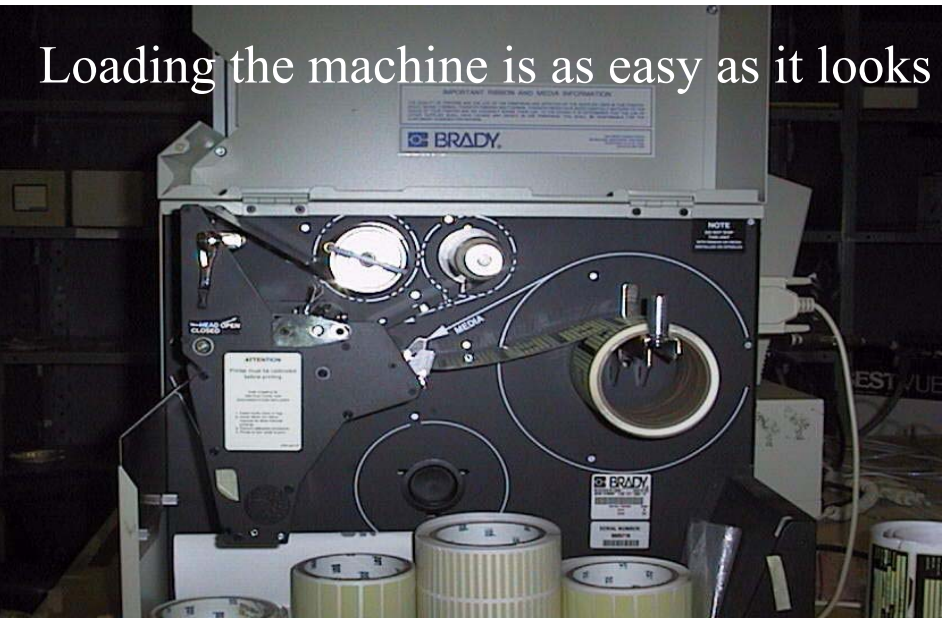


- **Initial set up for any label size**
  - **5 minutes to program computer with label dimensions, for each operation after that using same size – 30 seconds (how fast can you type)**

- **Install labels into printer and calibrate for label size – 2 minutes**

The Brady machine

This Critchley Label Maker has been used for labeling circuit card assemblies.



Loading the machine is as easy as it looks

- **Point and click to bring up software package, point and click to bring up file, and point and click to print**
- **Print speeds of 2 to 6 inches per second**
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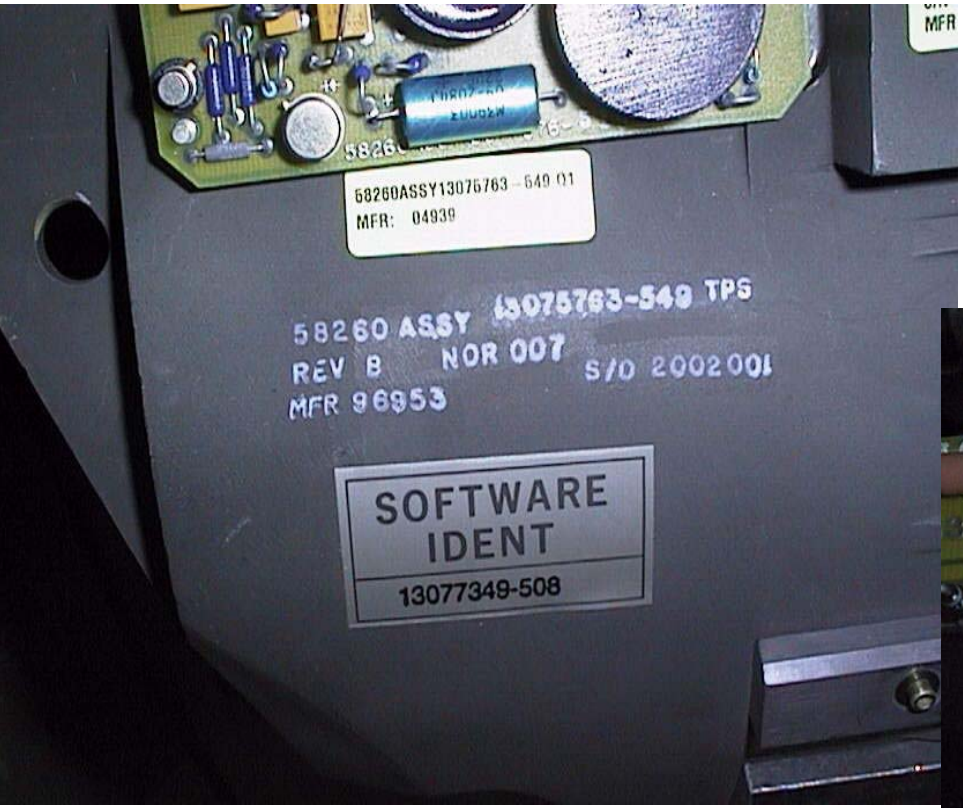


- Clean area with alcohol
- Blow area clean and dry with clean dry air
- Peel backing, position, and press down
- Apply pressure to entire area of label to fully activate adhesive
- Adhesive fully cured in 24 hours

Low/No-VOC Nonchromate Coating System for Support Equipment

Objective:

- Identify and qualify alternatives to conventional primers and topcoats containing hexavalent chromium, lead and VOCs (MEK and toluene) used for coating support equipment at DoD and NASA facilities which will reduce VOC emissions, reduce hazardous waste and reduce waste management costs.

Benefits:

- Reduce regulatory financial liabilities
- Reduce worker exposure

Technology:

- Support equipment affected
  - Mobile and fixed combat and aviation related equipment
  - Powered and non-powered ground support categories

Technology (continued):

5 types of alternative coatings processed in coupon testing

- **Advanced film technology (Applique)**
- **Metal wire arc spray**
- **High solid coatings**
- **Powdered coatings**
- **Waterborne coatings**

Low/No-VOC Nonchromate Coating System for Support Equipment (continued)

Technology (continued):

2 powdered coatings and 2 waterborne coatings selected for field evaluation

- DuPont Powder Coating, Gray Morning Epoxy ELH503S5055 Primer with DuPont Sky White (TGIC)PFW510S9 Topcoat and Morton Powder Coatings Zinc Rich Gray Epoxy 13-7004 Primer with Morton Corvel White TGIC 30-1007 01578-1
- Deft Zinc Rich Primer (44-GY-16) with Deft Intermediate Primer (44-W-007) and Defthane Zero-VOC Topcoat (55-GY-005) and Waterborne Deft Zero VOC Topcoat faded (does not meet Air Force standards)
- Control Coatings high-VOC MIL-PRF-53022 Primer with MIL-PRF-85285 Topcoat

Accomplishments:

- JTR completed August 2003, includes 18 month Marine corrosion test results
- Field evaluations completed at Naval Air Station Brunswick, Solomons, Patrick Air Force Base (AFB), and Cape Canaveral AFB

Alternative to VOCs in Coating System

- **Solventless Seawater Ballast Tank Coating System – Implemented by Navy**
  - Reduced VOC releases and worker exposure
  - Expanded on previous successful Navy efforts to implement the use of solvent-free coating systems on DoD ships, boats and small-craft
  - Cost $800 K
  - Cost Avoidance $236.5 M over 20 years
  - Estimated Savings $107 K/ per coated tank, thus far - $4.8M

•Chromium-Free Primers for Inserts and Fasteners – Implemented

- Partners – U.S. Air Force, Navy, and Pratt & Whitney
  - Migrated to G.E. engines
- Qualified three (3) chromium-free primers for providing galvanic corrosion protection to inserts and fasteners used in aircraft engines
- Reduced worker exposure to hexavalent chrome in primers for engine assembly and rework
- Reduce hazardous material handling, storage, and waste

Portable Laser Coating Removal System

Objective:

- Demonstrate feasibility of using a compact, portable, low-powered, hand-held laser system on small areas, complex geometry, irregular surfaces and hard-to-reach areas on aircraft, ground vehicles, components, and support equipment to remove their coating systems. Reduce costs and labor hours, as well as to eliminate the use of hazardous materials, such as methylene chloride, that are used to remove today's military and commercial coating systems to reduce waste management costs.

Benefits:

- Reduce regulatory and financial liabilities
- Reduce personal protective equipment
- Improved maintenance processes

Technology:

- Laser systems selected for testing

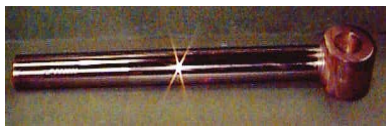
Accomplishments:

- Metallic test coupons are in testing
- First full article demonstration scheduled for Hill AFB in February 04
- United Space Alliance evaluating for robotics

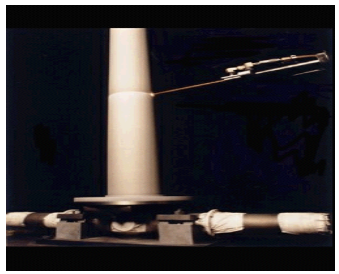
Chromium Electroplating Alternatives Projects
High Velocity Oxy-Fuel (HVOF) Technology Migration

Helicopter dynamic components

Propeller hubs



Pneumatic actuators



Aircraft landing gear

Description:

Support the Hard Chrome Alternatives Team (HCAT) efforts to validate HVOF thermal spray coatings as a replacement for hard chrome plating for specific applications

Alternatives:

- **Tungsten Carbide Cobalt (WC/Co)**
- **Tungsten Carbide Cobalt Chrome ($WC/CoCr^{+3}$)**
- **Tribaloy T-800 (Co, Ni based alloy)**

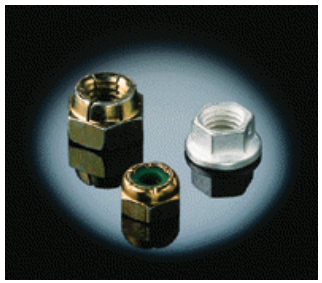
Benefit/Impact:

- **Reduces chromium emissions and discharges**
- **Reduces corrosion**
- **Increases life of wear components up to 8 times more than non-coated components**
- **Cost savings due to increased life and less downtime**

Status

- **Coupon testing complete**
- **Article testing in-progress**

Joint Cadmium Alternative Team (JCAT) Projects



Common Fasteners

Electrical Connectors

Plating

Description:

- The objective of the JCAT is to reduce and if possible eliminate the use of cadmium on all DoD and NASA hardware.
- Primary process focus is electroplating.

Potential Alternatives:

- Tin-zinc
- Zinc-nickel
- Al-manganese
- IVD aluminum
- Sputtered Al
- Alumiplate
- LASER Induced Surface Improvements (LISI)

Applications:

Corrosion protection and lubricity for high- and low-strength steels and other metal alloys. Initial focus applications:

- Alternatives to cadmium electroplating for non-aerospace applications (BISDS follow-on)
- Fasteners
- Springs
- Structural components
- Electrical connectors

Milestones:

- Boeing Information and Space Defense Systems
  - Testing complete
- Testing development continues
  - Electrical Connectors testing
  - Fasteners in testing
  - Structural components and Springs
  - High strength steels

Non-ODC Oxygen (O2) Line Cleaning System

Objective:

Air Force, Navy, and NASA jointly pursued two technical approaches to certify and demonstrate the best solution for ODS-free O2 line cleaning – aircraft and O2 carts

Benefits:

- Reduce DoD and NASA consumption and emission of CFCs
- Significant savings in manpower and aircraft downtime

Technology:

- Evaluated 3 Technologies:CFC-free materials
  - Versar Inc., On Board OLCS
  - Northrop-Grumman, Off Aircraft OLCS
  - NAVY: Navy OLCS
- Technologies evaluated under this project may be applicable to cleaning of other types of O2 systems onboard ships, submarines, and medical equipment
- Some engineering and testing will be required to adapt technologies to other specific applications

Accomplishments:

- Demonstrated on F-15, F-16, C-130, and B-1 aircraft